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MEASURING INSTRUMENTS • TELEMETERS • AUTOMATIC CONTROLS • HEAT-TREATING FURNACES

Innovations in Instruments

At a joint meeting of the New York Section of the American Chemical Society and the Society of Chemical Industry at New York University on December 11, 1936, the following instruments developed by Professors Ralph H. Müller and Raymond L. Garman of that university were demonstrated:

(1) *Telecolorimeter:* This instrument will reproduce a color at a distant point. An operator in an industrial plant may watch a color and the settings which he makes on the instrument are immediately repeated and retranslated into the same color in a remote office. The contents of a tank or kettle may be scanned automatically by the instrument and the prevailing hue be repeated at the receiving end. The two color instruments are inter-connected with self-synchronizing motors which are the electrical equivalent of gears. With slightly more complicated arrangements the controlling can be done over a telephone or even by radio.

(2) *Cathode-Ray Spectrophotometer:* This instrument measures the amount of light reflected or transmitted by the colored substance at every point in the entire spectrum. By means of a motor-driven lens, a complete spectrum is whirled past a slit. A photo-cell behind this slit translates each color of the spectrum, as it passes, into a feeble current, the strength of which is at all times proportional to the intensity of that color. After amplification the current is impressed on a cathode-ray tube. The color curve now stands out as a luminous trace on the screen of the tube. Thus the entire spectrophotometric curve stands out clearly. In many cases an expert can identify immediately the substance which gives rise to this curve. Thus blood shows a very definite, easily recognizable absorption curve.

(3) *Automatic Viscosimeter:* One of the standard methods of measuring viscosity has been to drop a steel ball into a long column of the oil and to measure the time necessary for it to sink to the bottom, or more precisely to pass between two marks on the column. If the oil is very dark it is impossible to see the ball. Some years ago, it was suggested that coils be wrapped around the tube at these two points and then connected in an oscillating circuit (like the old regenerative or "squealer" radio sets). Then as the ball crossed the line one could hear a "tweet" and know when to start and when to arrest the stopwatch.

The present instrument makes it unnecessary to listen for these sounds, but utilizes the "pulses" directly to start and stop an electric clock. A thyratron inverter circuit performs this function directly. One tube "fires" at the starting impulse and holds the clock in the operating condition. The second pulse extinguishes the first thyratron and stops the clock. Time intervals as small as two thousandths of a second are detectable.

(4) *Recording Analytical Balance:* In many problems it is desirable to follow slow changes in weight such as are caused by the absorption of moisture or gases. The present instrument records such changes automatically and will run for hours at a time, drawing a curve on a moving paper chart. The pointer of the balance is scanned by a light beam. If it moves ever so slightly due to a change in weight of the sample, the beam is cut off, and a photo-cell starts a motor which rebalances the instrument. The rebalancing is accomplished by lengthening or shortening a gold chain which hangs from one arm of the balance beam. The amount of compensation effected by the motor is at the same time followed by a standard electrical recorder which prints the record. Signal lamps indicate whether the instrument is in the balanced or unbalanced condition.

At the meeting of the Founder Societies of the American Institute of Physics, last October, an exhibit of the Kodak Research Laboratories demonstrated the principles underlying the subtractive method of three-color photography. By means of overlapping filters which transmitted the subtractive primaries, blue-green, yellow, and magenta, it was shown how primary red, green, and blue, as well as black, could be formed. A process known as Kodachrome employs a film in which the image is formed in three layers, one over the other, each layer containing one of the subtractive primary colors. The original film consists of three emulsions separated by gelatin interlayers. By suitably sensitizing the emulsions and by the use of appropriate filter dyes between the layers, the emulsion nearest the support is made to respond only to red light, the middle emulsion to green light, and the top emulsion to blue light. In this way in the camera there is produced a separation of the colors of the subject into their blue, green, and red components in the depth of the film coating. In processing, the film is developed to give a direct positive dye image in which the photographic record in each layer is converted to a dye image, the color of which is complementary to the spectral region to which the layer responded. That is, the image in the top, blue sensitive layer is converted to yellow, that in the middle, green sensitive layer is converted to magenta, while that in the bottom, red sensitive layer is turned into blue-green dye.

In the exhibit, cross sections were shown of Kodachrome film and specimens of film were shown removed from the processing solutions at various stages. The results obtainable by this process were illustrated by specimen pictures on films of all the sizes in which it is available at the present time, i.e., 8 mm, 16 mm, and 35 mm for the miniature camera, for exposures both by artificial light and daylight.